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INFRARED ABSORPTION MEASUREMENT OF HCl, HF, AND N_2O AT SYOWA STATION (ABSTRACT)

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Vertical column densities of HCl, HF, and N_2O were observed using the solar infrared absorption method at Syowa Station, to study the chemistry and dynamics of Antarctic ozone depletion. The spectra were taken by using a 1.5 m double-pass grating monochromator with wavenumber resolution of 0.09 cm^{-1}. The measurements were carried out from July to December 1991. HCl vertical column densities were found to be $(1.65\pm0.43)\times10^{15}$ cm^{-2} in winter, and increased to $(6.07\pm1.20)\times10^{15}$ cm^{-2} in summer. HF and N_2O vertical column densities remained fairly constant at $(1.31\pm0.25)\times10^{15}$ cm^{-2} and $(5.98\pm0.31)\times10^{18}$ cm^{-2}, respectively, from July to December, suggesting stable dynamical conditions. The time variation of the HF/HCl ratios shows that only HCl was removed by chemical reactions during the polar night. These reactions might occur on the surfaces of the polar stratospheric cloud (PSC) particles in the altitude region between 12 km and 25 km. The decrease in HCl vertical column density (about 4.4×10^{15} cm^{-2}) during the polar night implies that almost all the HCl molecules in this altitude region were converted into other chlorine compounds. The temperature and wind measured by rawinsondes over Syowa Station show that the air mass in the 'ozone hole' remained dynamically stable, particularly in August and September. Total ozone measured by Dobson spectrometer shows that Syowa Station was located directly beneath the 'ozone hole' in mid-November, whereas the HCl vertical column density had recovered to the summer level at that time. These mean that the increase in HCl vertical column density from September to November is mainly due to chemical reactions. A comparison with the calculation from a one-dimensional time-dependent photochemical model shows that half of the decrease in HCl vertical column density is converted into active chlorines and that the remainder is converted into other chlorine compounds or trapped in the PSC particles.

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